last column gives the average composition of four typical oils as analysed by Brame.

ANALYSES OF LIQUID FUELS

	Borneo.	Burmah.	Texas.	Mexico.	Russia.	Scotch Shale.	Scotch Blast-furnace.	Average of Four Typical Oils.
Carbon	87-89%	86-40%	83-84%	85'85%	84-94%	83-77%	82-30%	84-70%
Hydrogen	1078	12-10	12-48	10-82	13-96	13-25	10-11	11-50
Oxygen,	1-34	1-50	3-68	3-30	1-25	2-98	7'59	3'49
Sulphur	—	—	—	—	—	—	---	0-35

The suitability and value of a particular oil for fuel purposes must be determined by its calorific value (net), viscosity, flash-point, and purity in respect of water, sand, and sulphur independently of its source.

Calorific Value.—The average calorific value of thirteen varieties of fuel oil as determined by Brame was 19,200 B.Th.U. (gross), but this is probably rather above the general figure for market oils. The value should not fall below 18,000 B.Th.U.

Viscosity.—Viscosity varies within wide limits. It is lowest in the case of shale oils, while Mexican oils are sometimes very viscous.

Flashpoint and Specific Gravity.—For Admiralty use the flash-point should be above 175° F., and in the case of low viscosity oils, such as shale, should reach at least 200° F. In the case of the mercantile marine a flash-point of 150° F. and over is suitable. The specific gravities of liquid fuels range from 0-875 f°r shale oil to 0-96 in the case of the heavier earth oils and 0-98 for blast-furnace oil. When comparison is made between mineral oils of similar constitution, a relation is established between specific gravity and volatility, the specific gravity showing a progressive increase as the volatility diminishes till the solid oils are reached. The fact, however, that the oils from different fields are differently constituted, and the presence in them of variable amounts of oxygen and sulphur compounds, make it impossible to extend the relationship to oils derived from different sources.

Combustion of Oils.—For the complete combustion of oils it is necessary to ensure their efficient dispersal through the air required for

combustion. In the case of the more volatile oils this is done by converting into vapour in a suitable carburettor. The heavy oils used for combustion under boilers are atomized either by means of a steam jet or by air or by the direct breaking-up into spray of a jet of oil caused to issue under pressure. The difficulty is in all cases to ensure regular and smokeless combustion. Steam has the drawback of rendering latent a part of the heat which is carried away in the gases of combustion, and steam atomizers have been characterized further as not responding as well as air and pressure systems to any forcing of the boilers. The following description of the Wallsend-Howden pressure system which has been widely adopted on boilers for marine and land use will serve to illustrate the principle of mixing the air-supply with the oil.